A First Analysis of Callisto Using Galileo NIMS and SSI Measurements

T. B. McCord[1,2], K. C. Bender[3], G. B. Hansen[1], C. A. Hibbitts[1], J. Granahan[1,2], M. Segura[4], R. W. Carlson[4], W. Smythe[4], R. Greeley[3], P. Geissler[5], M. J. S. Belton[6], and the NIMS and SSI Teams.

[1]Hawaii Inst. Geophys. & Planet., U. Hawaii, Honolulu HI 96822, [2]SETS Technology, Inc., Mililani HI, [3]Arizona State U., Tempe AZ, [4]Jet Propulsion Lab., Pasadena CA., [5]U. of Arizona, and, [6]NOAO, Tucson AZ.

The NIMS (Near Infrared Mapping Spectrometer) [1] and SSI (Solid State Imager) [2] experiments on the Galileo Mission made coordinated observations of Callisto. NIMS is an imaging spectrometer which provides up to 408-channel spectra in steps of x2 (102, 204, 408 channels) over the spectral range of 0.7 to 5.2 μm and spatial resolution elements varying from near one km to hundreds of kms. SSI is a framing multispectral camera which produces images at up to 7 spectral bands with an angular resolution a factor of 50 higher than NIMS. On November 4, 1996, the Galileo spacecraft had is first close encounter of Callisto at an altitude of 1219 km. A coordinated data set acquired during this pass includes (see Segura *et al.*, these proceedings): 1) a mosaic of SSI images taken by the camera at a resolution of 1 km/pixel, 2) a 5-filter **[**violet (0.404 microns), green (0.559 microns), continuum (0.756 microns), strong methane (0.887 microns) and infrared (0.986 microns)**]** at about 10 km/pixel, and 3) a NIMS mosaic of a similar area at 102 wavelengths and 20 km/pixel. The images comprising the first mosaic were taken through the clear filter and provide the high resolution context for the rest of the data set. However, the color mosaic was employed for the selection of the albedo features used in this preliminary study.

The Asgard multi-ring structure has been a high priority target for both instruments. This 1640 kilometer diameter feature is the second largest ring structure on Callisto and is interpreted to have formed early in Callisto's history by a major impact event. The structure consists of a central high albedo plains (~350 km in diameter) surrounded by discontinuous ridges and troughs. The high albedo and lower crater density of the central plains as seen in Voyager images now appears to be, in part, related to a younger dome crater and its ejecta which has been superimposed on the south-western part of this feature. The predominant structural features of Asgard include ridges concentric with the inner plains and troughs found at the margin of the structure. The troughs are less concentric than the scarps and may represent heterogeneities in the crust at the time of formation which controlled their orientation. In addition, several large craters occur in the area which post-date the Asgard structure.

The spectral features discovered by NIMS ([1, 3]; McCord *et al.*, these proceedings) include weak absorption bands near 3.88, 4.05, 4.25 and 4.57 μm for Callisto with maximum strengths of 5%, 12%, 40%, and 12%, respectively. The strengths of these features have been mapped and compared with the spatial features and multispectral units identified by Voyager and SSI. The spatial distributions of these absorption bands (see McCord *et al.*, these proceedings) appear mostly independent of each another, implying that several materials are responsible. The 4.25 μm absorption band depth has a similar but not identical spatial pattern to that of the water-ice absorption bands. The 4.05 μm absorption band depth is strongest in the area of the concentric rings around Asgard and is conspicuously absent in the central plains.

The merging of spectral maps (from NIMS and SSI) with the SSI high resolution images provides for correlation of spectral properties with structural, morphological and albedo features. Shown below are four figures, each with an identical overly of some key morphological features and the blue SSI spectral unit, derived from the low-resolution color observation. Figure 1 is the high-resolution SSI image that shows the finest detail of the region. The Asgard Basin (A) and Tornasuk crater (T) are labeled. Note that the blue spectral unit correlates very well with the depth of the NIMS 1.48 μm ice band (Figure 2), indicating that the blue color is due to the presence of more water ice, probably related to crater ejecta. Figures 3 and 4 show correlations of band strengths at 4.25 μm and 4.05 μm, respectively, with morphology. Combined analysis of the full suite of spectral (0.4 to 5.2 microns) and high spatial resolution data will increase the value of both data sets.

REFRENCES:

[1] Carlson, R. W., *et al.*, *Science, 274*, 385, 1996.
[2] Belton, M. J. S., *et al.*, *Science, 274*, 377, 1996.
[3] McCord, T. B., *et al.*, *Bull. Amer. Astron. Soc., 28*, 1138, 1996; McCord, T. B., *et al.*, *Trans. Amer. Geophys. Union, 77*, F445, 1996.

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